UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
WASHINGTON, D. C.
H. H. BENNETT, CHIEF
W. C. LOWDERMILK, ASSOCIATE CHIEF

***

ADVANCE REPORT

on the

SEDIMENTATION SURVEY OF LAKE BRACKEN

GALESBURG, ILLINOIS

July 9 - August 15, 1936

by

Victor H. Jones

***

In Cooperation With

Illinois Agricultural Experiment Station
Urbana, Illinois
H. W. Mumford, Director

and

Illinois Department of Registration
Water Survey Division
Urbana, Illinois
A. M. Buswell, Chief

Sedimentation Studies
Division of Research
SCS-SS-14
May, 1937

ADVANCE REPORT ON THE

SEDIMENTATION SURVEY OF LAKE BRACKEN

GALESBURG, ILLINOIS

GENERAL INFORMATION

Location (fig. 1):

State: Illinois.

County: Knox. Secs. 3, 10, 11, 12, and 14; T. 10 N., R. 1 E.

(Cedar Township)

Distance and direction from nearest city: 5½ miles due south of the city square of Galesburg, Ill.

Drainage and backwater: Brush Creek and small tributaries. Brush Creek flows generally southeastward nearly 10 miles to join Haw Creek 3 miles above its confluence with the Spoon River, a tributary of the Illinois River.

Ownership; Chicago, Burlington, and Quincy Railroad.

Purpose served: Water supply for locomotives and local shops of the railroad. It is also used extensively for recreational purposes, chiefly by members of the Knox County Country Club.

Description of dam: Lake Bracken is impounded by an earthen dam 650 feet long, 49 feet in maximum height above the valley bottom, and 12 feet wide at the top. The average elevation of the top of the dam is 707 feet above sea level or 7 feet above spillway crest level. The upstream face of the dam, on a slope of 3:1, is covered with a riprap of loose rock to a height of 4 feet above crest level. The slope of the downstream face is 2:1. Considerable seepage through the dam, especially near the old creek channel, was observed during the survey.

The concrete spillway at the west end of the dam, constructed in its present form in 1927, possesses several unusual features. Water approaches the spillway through a flat-bottomed channel, about 100 feet long and 25 feet wide, having scarcely any depth below the level of the spillway. The crest of the spillway is 214 feet long, 42 feet above the valley bottom, and 700 feet above sea level. The overflow descends to the level of the valley below the dam over a series of steps between concrete wingwalls. A heavy iron plate with calibrated V-shaped notches

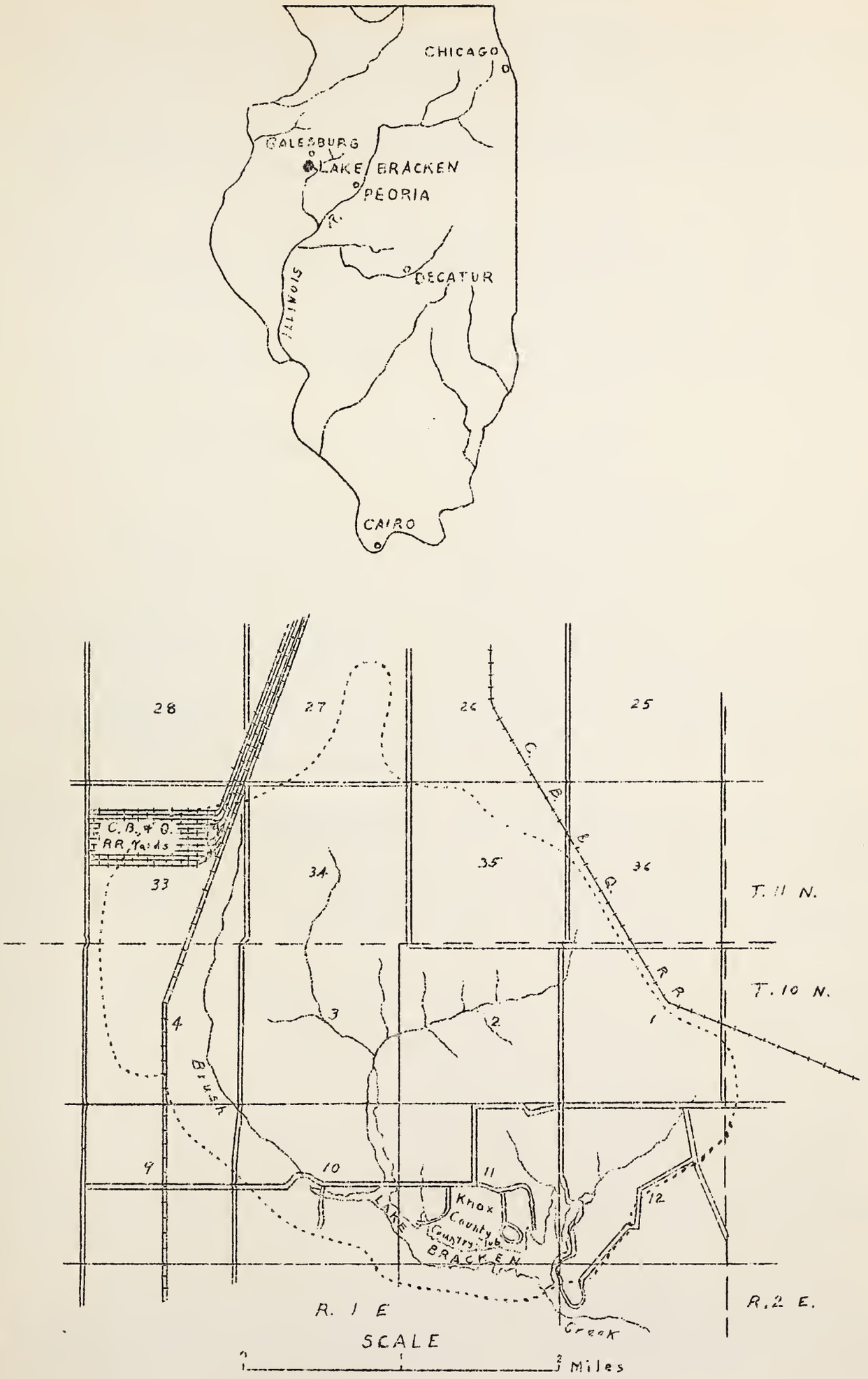


Fig.1- Location and general relations of Lake Bracken and its watershed.

along the top of the highest step was installed in 1931 as a means of measuring the overflow. (See fig. 2).

Date of completion: December 1, 1923. The dam was not entirely finished until December 1924, but pumping from the partly filled lake was begun at the earlier date.

Length of lake: The extreme length is on Brush Creek, where the distance from the dam to the head of backwater is 9,400 feet. Reduction in length by sedimentation has occurred only in the north arm (segments 26 and 27), which was reduced from an original length of 2,600 feet to a present length of 2,300 feet, a reduction of 300 feet. The two arms extending northward from the dam are 2,400 and 3,200 feet long, respectively.

Area of lake at crest stage:

	Acres
Original.....	186
Present.....	184
Reduction.....	2

Storage capacity at crest stage:

	Acre-feet	Gallons
Original.....	2,881	938,773,850
Present.....	2,660	866,761,000
Reduction by sedimentation.	221	72,012,850

General character of reservoir basin: Lake Bracken is long, narrow, and sinuous in general outline, but its shore line is made very irregular by several tributary arms (fig. 3, following page 10) The main lake is nearly 2 miles long and is 500 to 600 feet wide through most of its length, tapering gradually toward the head of backwater.

The lake is deep in proportion to its width because it occupies a youthful section of the valley, which is incised in Pennsylvanian sandstone. Along all shore lines the submerged slopes are precipitous except at the heads of the several arms and bays. On range R1-R2 near the dam the original depth was nearly 38 feet in the old creek channel and 34 feet on the narrow flood plain, although the width of the valley bottom on this range is less than 250 feet. The gradient of the submerged creek channel is about 19 feet per mile within the limits of the reservoir. The length of ponded channel at the heads of the several arms does not in any instance exceed 350 feet.

Road fills have been built across major arms in segments 9 and 23 and across minor arms in segments 6 and 21. Water from these arms reaches the main lake through the embankments by way of metal culverts about 4 feet below crest.

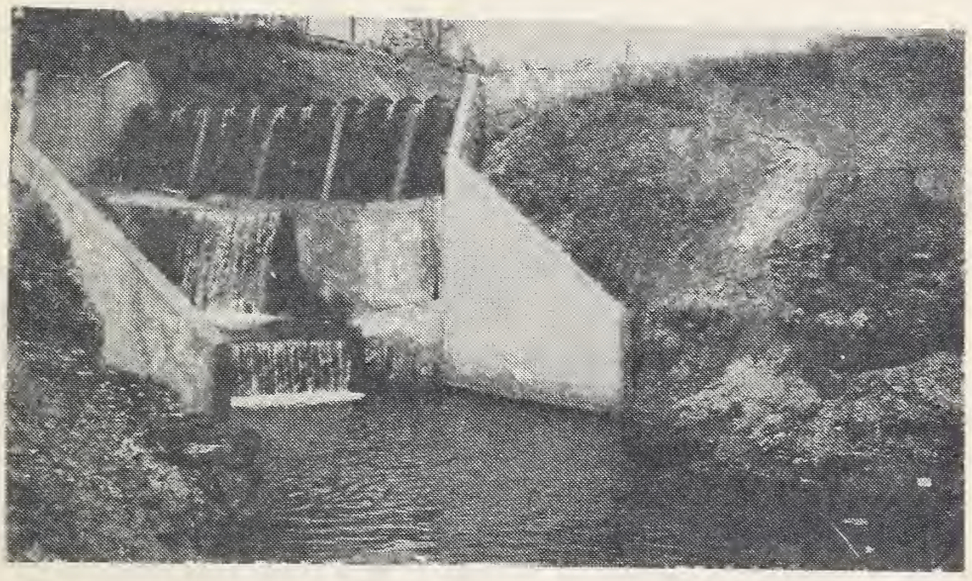


Figure 2. Spillway of Lake Bracken Dam, showing the calibrated notches for measuring overflow.

Area of watershed: 5,700 acres, or 8.91 square miles, as planimetered from the topographic map of the Galesburg quadrangle (Edition of 1927).

General character of watershed:

Geology: The entire watershed lies within the glaciated area of the Mississippi Valley plain, included in the Central Lowland province. Indurated rocks of Pennsylvanian age crop out only along the steep slopes of the deeper valleys, and are not exposed in the peripheral areas of the watershed. Illinoian glacial till, and loess of at least one later Pleistocene epoch, cover the bedrock nearly everywhere. The following table indicates stratigraphic relations, approximate average thicknesses, lithological compositions, and degrees of erosion of surface and near-surface formations.

Table 1.--Geologic formations of the Lake Bracken watershed

Age	Lithology	Thickness	Degree of erosion
		Feet	
Pleistocene:			
Peorian and later.	Loess.....	12	Moderately eroded on uplands. Severely eroded along major valleys. Covers nearly entire watershed.
Illinoian....	Gumbotil....	3	Eroded on some slopes. Small outcrop area.
	Till.....	35	Eroded on most valley slopes.
Pennsylvanian:			
Pottsville...	Sandstone,.. shale, coal	330+	Exposed only in the steep walls of major valleys.

The loess is a powdery soft eolian deposit consisting chiefly of silt-size particles which are highly angular and mineralogically heterogeneous. Although the loess was originally calcareous the uppermost 5 feet, on the average, has been leached of calcium carbonate. The loess is highly porous and prevailingly buff in color. It is the parent material for a high percentage of the soils and is characterized by a peculiar ability to maintain vertical faces as it undergoes erosion.

Gumbotil[1/] is a highly plastic non-porous product of thorough leaching of the Illinoian till. It is agriculturally undesirable in that it interferes with drainage where covered by less than 6 feet of loess, but its effect on sedimentation in Lake Bracken is negligible.

1/ Kay, G. F. and Pearce, J. N., The origin of gumbotil: Jour. Geol., vol. 28, pp. 89-125, 1920.

The Pennsylvanian sandstones which crop out around the lake are fine grained, very thin bedded, micaceous, and have a moderate degree of cementation.

Topography and drainage: As a whole the watershed is in a youthful stage of regional topographic development. The valleys are V-shaped, short, and have high gradients. At least one-third of the area lies on the loess-covered upland of the gently undulatory Illinoian till plain, into which the gullies and larger valleys have not yet extended their heads. Most of the nearly flat plain in the northern and western portions of the watershed lies between 780 and 800 feet above sea level. Thus the maximum relief of the watershed is about 100 feet. All streams contributing to the lake are intermittent.

Soils: According to classification and mapping by the Soil Survey Division of the Illinois Agricultural Experiment Station,[2/] five principal soil types occur in the Lake Bracken watershed. These types, with their physical characteristics and approximate relative extents in the watershed are listed in the following table.

Table 2.--Soil types of the Lake Bracken watershed

Soil type	Description	Percentage of area
Black clay loam (Type No. 520)	Very dark soil developed on flat swampy upland under grasses.....	6
Brown silt loam (Type No. 526)	Dark upland prairie soil developed under native grass.....	60
Yellow-gray silt loam (Type 534)	Upland timber soil developed under forest on moderate slopes.....	15
Yellow silt loam (Type No. 535	Upland timber soil developed on steeper slopes along valleys.....	15
Deep brown silt loam (Type 1326)	Bottomland soil of variable texture and fertility.....	3

All the upland soils and much of the soil of the limited area of bottomland in Brush Creek valley are derived from the loess.

Erosion conditions: In northern parts of the watershed, comprising about 60 percent of the total area, concentrated channel erosion in gullies and valleys is practically absent. Sheet erosion, however, is slight to moderate in extent. Farther south in the

2/ Hopkins, Cyril G., Mosier, J. G., Pettit, J. H., and Readheimer, J. E., Knox County soils: Illinois Agr. Exp. Sta. Soil Rept. No.6, 1913.

watershed, near the main stream courses, erosion of the channel type becomes much more severe, and some dangerous gullies are developing, as in sections 2, 3, 10, 11, and 12. (fig. 1). Wherever the original dense forest and grass cover has been preserved along the valley slopes, erosion has not become destructive, but in some areas, especially in sections 10 and 12 where much of the oak forest has been cut for lumber, this protection has not been maintained. Soil conservation practices in general have not come into use in this watershed.

Land use: Although the entire watershed of Lake Bracken is typical of western Illinois agricultural areas, it can be conveniently divided into two parts with respect to land use, namely; a northern part, including sections 1, 27, 33, 34, and 35, characterized by flat topography, and a southern part, including sections 2, 3, 4, 10, 11, and 12, characterized by V-shaped valleys and numerous gullies. Table 3 shows the proportion of land devoted chiefly to each of the various land uses.

Table 3.--Land use in the Lake Bracken watershed

Use	Northern section	Southern section
	Percent	Percent
Crops:		
Corn	65	1/
Wheat	5	1/
Oats	8	1/
Hay crops	5	1/
Total	83	16
Forest	0	35
Pasture:		
Forest	0	35
Open	10	10
Total	10	45
C. B. & Q. R. R. yards	7	0
Lake	0	4
Total	100	100

1/ Separate figures not available.

These figures pertaining to land use are based upon observations made during the survey, and should be regarded as only approximate. Although advanced soil-conservation practices have not been adopted in the watershed the present use of land appears to be, in general, not inappropriate. Most of the steeper slopes of the inner watershed are protected by an efficacious grass or oak forest cover. On the grounds and properties of the Knox County Country Club, along the north shore of the lake, a good stand of native white oak has been preserved.

Mean annual rainfall: 35.8 inches, according to records of the Illinois Water Survey Division.

Inflow: Data on inflow into Lake Bracken are incomplete, but records of the State Water Survey Division show that the inflow was about 1,100 acre-feet in the calendar year 1935 and 4,000 acre-feet in the hydrologic year 1935-36. Both figures are exclusive of loss from evaporation, of which no record has been kept.

Draft on reservoir:

	Gallons per day
Maximum	1,500,000
Minimum	950,000
Average	1,250,000

HISTORY OF SURVEY

The survey of Lake Bracken was made by the Central Reservoir Party, Section of Sedimentation Studies, Division of Research, between July 9 and August 15, 1936. The field personnel was as follows: L.M.Glymph, Jr., chief of party; V.H. Jones, assistant chief; W.G. Shannon; H. L. Fischer, and O.D. Price. Preliminary arrangements for the survey were made by D. H. Eargle.

Primary triangulation involved the establishment of a 1,000-foot base line measured by steel tape along the graveled road adjacent to segments 23 and 28 (fig. 3, following page 10). From this base 29 triangulation stations were established as a system of control for all mapping. The lack of a suitable original map necessitated complete mapping of the shore line, which was done with plane table and telescopic alidade on a scale of 200 feet to the inch. Original and present storage capacities and silt volumes were determined by the range method.3/ Thirty ranges were established, sounded, and spudded, and 10.9 miles of shore line was mapped, including both original and present lake margins at the heads of the three tributary arms. Permanent monuments, consisting of iron pipe stamped with the station numbers and set in concrete bases, were used to mark the triangulation stations, range ends, and cut-in stations.

Under the terms of a cooperative project agreement with the Illinois Agricultural Experiment Station and the Water Survey Division, Illinois Department of Registration, the field party assisted in the collection of silt samples for chemical analysis of plant food elements.

Samples of bottom sediment were obtained from 14 well-distributed locations in the main reservoir and the principal arms and were analyzed in the laboratories of the Division of Soil Analysis, Illinois Agricultural Experiment Station. Dr. E. E. DeTurk and R. H. Bray of the Division of Soil Analysis cooperated in the field sampling and supervised

---

3/ Eakin, H.M., Silting of reservoirs: U.S.Dept. Agr. Tech. Bull. 524, pp. 129-135, 1936.

the analyses. Sampling equipment included the regular spud and a 1½-inch tubular sampler designed during the course of the survey. The latter consists of a 4-foot length of galvanized iron pipe with an outside bevel at the bottom and several holes punched through the upper end, which is attached by a reducer to a 4.5-foot length of 3/4-inch pipe. This sampler is attached to a rope by means of a T-joint and can be thrown and withdrawn in the same manner as the spud. It was used to obtain all submerged samples except where the sediment exceeded 4 feet in depth and was tenacious enough to adhere to the spud.

ACKNOWLEDGMENTS

The Soil Conservation Service acknowledges the generous assistance and cooperation of the Chicago, Burlington, and Quincy Railroad, particularly through Charles Bayliss, supervising engineer of the Galesburg Division, in supplying information on the lake and dam, early maps, material for construction of the survey monuments, and space for drafting, which was made available to the party when needed. E. C. Stewart, pump engineer at the lake, provided storage space for equipment during the survey and information on the quantity of water pumped from the lake.

Acknowledgment is made to Arnold Sweborg, secretary, and Roy Damburg, athletic director of the Knox County Country Club for data on the lake and for the use of boats during the survey.

The Illinois Water Survey Division furnished information on rainfall and other climatic factors. Geological bulletins and topographic maps were obtained from the Illinois Geological Survey Division.

SEDIMENT DEPOSITS

Character of sediment: Field examination indicates that most of the bottom sediment consists of relatively coarse silt with a small percentage of very fine sand; it is smooth to the touch but does not adhere strongly to the spud. The prevailing color of silt over the lake bottom is deep blue-gray, but it contains streaks and bands of black carbonaceous matter representing vegetal debris carried into the lake by floods.

Narrow shore zones resulting from wave erosion consist of poorly sorted sand, pebbles, and silt.

Distribution of sediment: The greater part of the submerged flood plain has received a relatively thin deposit of silt, and the accumulation in the channel in some places is only slightly thicker. In the lower 0.8 mile of the main basin, below range R31-R32, (fig. 3, following page 10) about 1 foot of silt covers the flood plain whereas the common thickness in the channel is 2 feet. Between range R31-R32 and the upper forks of the reservoir the silt thickness continues at 1 foot on the flood plain but ranges between 3 and 4 feet in the channel. On Brush Creek above the forks there is no distinct channel, and the silt

thickness increases more or less gradually from 1 foot on range R37-R39 to 2 feet on range R50-R51, and then increases suddenly to a maximum depth of 6.5 feet on range R52-R53, where a small delta has developed in the head of the arm.

The north arm, including segments 23 to 27, has received the heaviest accumulation in the lake. The deposit nearly everywhere exceeds 3 feet in thickness and on range R44-R45 attains a maximum depth of 6.6 feet. An extensive exposed delta at the head of this arm has advanced the shore line in one place about 450 feet downstream and has produced an average shortening of about 300 feet. Altogether, about one-third of the storage capacity of the north arm has been destroyed by sedimentation.

In the two arms extending northward from the dam the silt depth over most of the area is about 1 foot, although thicknesses of 3 to 5 feet were measured locally in the channels and near the heads of both arms.

The presence of highway fills in segments 9 and 23 has caused a concentration of sediment in the upper ends of the respective arms. Water is ponded there during floods and finds entrance into the main lake only through small culverts, and is thus effectively desilted. As a result, the storage capacity above these fills is being destroyed many times more rapidly than that of the remainder of the lake.

Origin of sediment: Loess and loess-derived soils, the surficial material over most of the watershed, are the chief sources of Lake Bracken sediment. Perhaps 90 percent or more of the silt has originated from erosion of the loess. Minor quantities of sand, gravel, silt, and clay have been derived from the Illinoian drift, and some fine sand and silt has been eroded from the Pennsylvanian sandstone exposed along the lake shore and in the deeper valleys.

The relatively large quantity of sediment in the north arm indicates that erosion in gullies and on slopes in sections 2 and 3 (fig. 1) contribute most of the silt now being deposited in Lake Bracken. The headwaters of this arm tap areas where removal of natural vegetation and cultivation of crops on sloping land have induced rapid erosion.

Little erosion by wave and current action has occurred along the shores of Lake Bracken. The slight "notching" along both shores of the main lake has furnished only insignificant amounts of sediment, chiefly pebbles, silt, and fine sand, to the reservoir. The shore zone deposits are definite but narrow, and have accumulated to depths of 2 feet on steeper slopes near shore. The crest level contour crosses the irregular contact between the Pennsylvanian sandstone and the overlying Illinoian till at many places, so that about 40 percent of the shore line is on sandstone and 60 percent is on glacial till. Springs of considerable volume issue from the contact zone and from bedding planes in the sandstone at several places, especially in segments 18, 19, 24, and 25 (fig. 3).

Conclusions: 1. The rate of erosion in the watershed, in terms of yearly accumulation of sediment in Lake Bracken, is comparatively high, amounting to nearly 2 acre-feet per year per square mile of drainage area. The watershed is so small, however, that the annual loss of storage amounts to only a little more than 0.5 percent of the original capacity of the lake. At the present rate of sedimentation, therefore, the life expectancy of the lake is about 150 years.

2. Examination of watershed conditions, together with the determined distribution of sediment, indicates that if rigorous soil conservation measures were immediately applied to the most severely eroding parts of the watershed, particularly sections 2, 3, and 34, the life expectancy of the lake would be more than doubled.

The following tabulation is a statistical summary of data pertaining to Lake Bracken, Galesburg, Ill.

	Quantity	Unit
Age[1/]	12.7	Years
Watershed:		
Total area	8.91	Square Miles
	5,700	Acres
Reservoir:		
Original area at crest stage	186	Acres
Present area at crest stage	184	Acres
Original storage capacity	2,881	Acre-feet
Present storage capacity	2,660	Acre-feet
Original storage per square mile of drainage area	323.34	Acre-feet
Present storage per square mile of drainage area	298.54	Acre-feet
Original storage per acre of drainage area	[illegible]6.06	Acre-inches
Present storage per acre of drainage area	5.60	Acre-inches
Sedimentation:		
Delta deposits	Not measured separately	
Bottom-set beds		
Total sediment	221	Acre-feet
Accumulation per year average	17.4	Acre-feet
Accumulation per year per 100 square miles drainage area	195	Acre-feet
Accumulation per year per acre of drainage area	132.97	Cubic feet
Or, assuming average weight of one cubic foot of silt is 100 pounds	6.65	Tons
Depletion of storage:		
Loss of original capacity per year.	0.60	Percent
Loss of original capacity to date of survey	7.67	Percent

1/ Date storage began: December 1, 1923.
Date of this survey: July 9 - August 15, 1936.

Figure 3

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

H. H. BENNETT, Chief W. C. LOWDERMILK, Assaciate Chief

LAKE BRACKEN
BRUSH CREEK
GALESBURG
ILLINOIS

SEDIMENTATION SURVEY OF JULY 1936

G. C. DOBSON, Acting Head, Sedimentation Studies, Divisian af Research

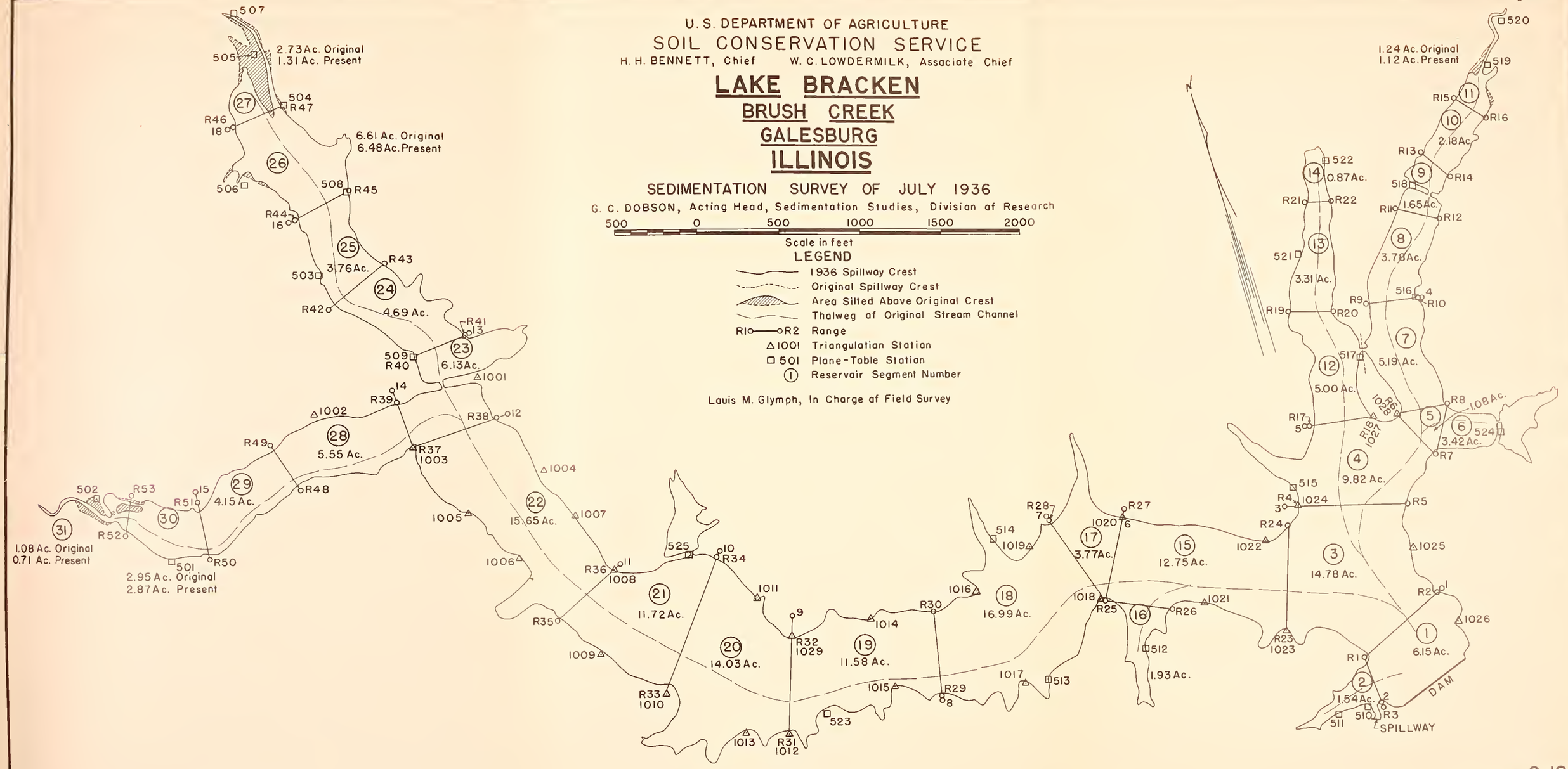
500 0 500 1000 1500 2000

Scale in feet

LEGEND

- 1936 Spillway Crest
- Original Spillway Crest
- Area Silted Above Original Crest
- Thalweg af Original Stream Channel
- R10—R2 Range
- △1001 Triangulatian Station
- □501 Plane-Table Station
- (1) Reservoir Segment Number

Lauis M. Glymph, In Charge af Field Survey



3-12-37 0-1845